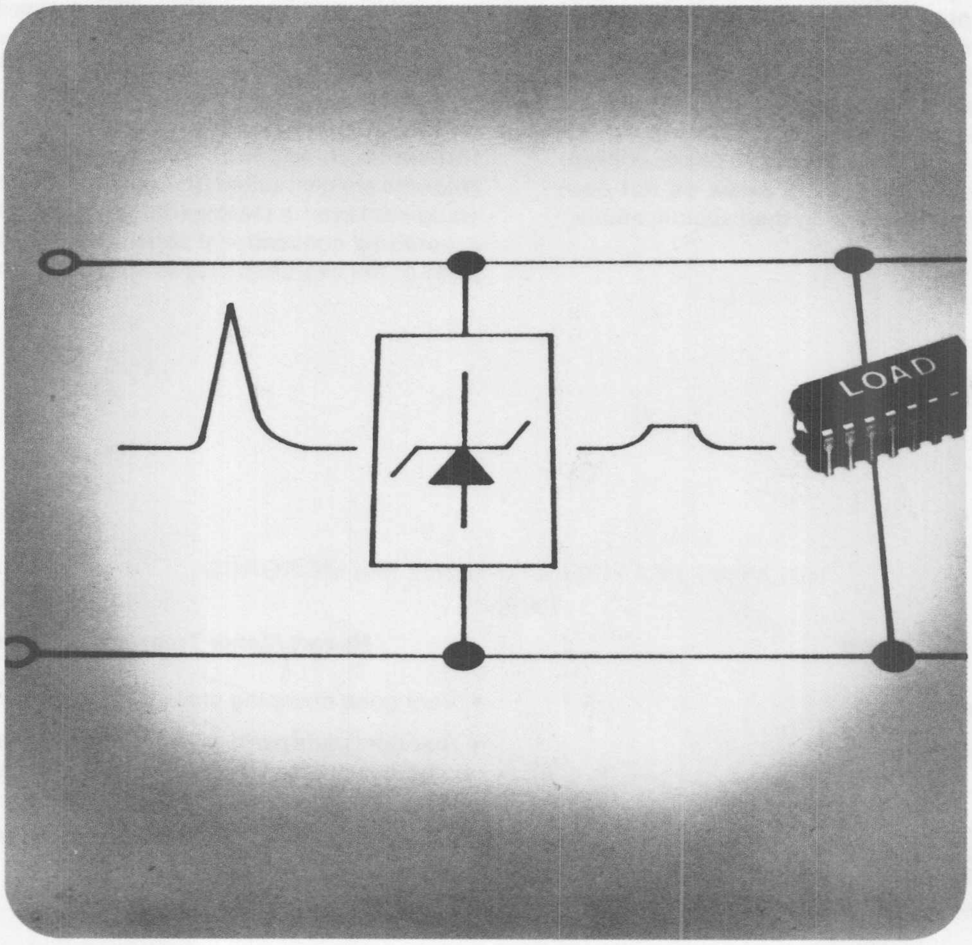
Some Straight Talk About Mosorbs*



*MOTOROLA HIGH CURRENT SURGE PROTECTORS

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SOME STRAIGHT TALK ABOUT TRANSIENT SUPPRESSORS

Distinction is sometimes made between devices trademarked Mosorb (by Motorola Inc.), and standard zener/avalanche diodes used for reference, low-level regulation and low-level protection purposes. It must be emphasized from the beginning that Mosorb devices are, in fact, zener diodes. The basic semiconductor technology and processing are identical. The primary difference is in the applications for which they are designed. Mosorb devices are intended specifically for transient protection purposes and are designed, therefore, with a large effective junction area that provides high pulse power capability while minimizing the total silicon use. Thus, Mosorb pulse power ratings begin at 600 watts — well in excess of low power conventional zener diodes which in many cases do not even include pulse power ratings among their specifications.

MOVs, like Mosorbs, do have the pulse power capabilities for transient suppression. They are metal oxide varistors (not semiconductors) that exhibit bidirectional avalanche characteristics, similar to those of back-to-back connected zeners. The main attributes of such devices are low manufacturing cost, the ability to absorb high energy surges (up to 600 joules) and symmetrical bidirectional "breakdown" characteristics. Major disadvantages are: high clamping factor, an internal wear-out mechanism and an absence of low-end voltage capability. These limitations restrict the use of MOVs primarily to the protection of insensitive electronic components against high energy transients in applications above 20 volts, whereas, Mosorbs are best suited for precise protection of sensitive equipment even in the low voltage range — the same range covered by conventional zener diodes. The relative features of the two device types are covered in Table 1.

RELATIVE FEATURES OF MOVs and MOSORBS
Table 1

MOV	Mosorb/Zener Transient Suppressor
• High clamping factor.	• Very good clamping close to the operating voltage.
• Symmetrically bidirectional.	• Standard parts perform like standard zeners and have to be ordered as specials for symmetrical bidirectional operation.
• Energy capability per dollar usually much lower than a silicon device. However, if good clamping is required a higher energy device would be needed, resulting in higher cost.	• Good clamping characteristic could reduce overall system cost.
• Inherent wear out mechanism clamp voltage degrades after every pulse, even when pulsed below rated value.	• No inherent wear out mechanism.
• Ideally suited for crude ac line protection.	• Ideally suited for precise dc protection.
• High single-pulse current capability.	• Medium multiple-pulse current capability.
• Degrades with overstress.	• Fails short with overstress.
• Good high voltage capability.	• Limited high voltage capability unless series devices are used.
• Limited low voltage capability.	• Good low voltage capability.

Important Specifications for Mosorb Protective Devices

Typically, a Mosorb suppressor is used in parallel with the components or circuits being protected (Figure 1), in order to shunt the destructive energy spike, or surge, around the more sensitive components. It does this by avalanching at its "breakdown" level, ideally representing an infinite impedance at voltages below its rated breakdown voltage, and essentially zero impedance at voltages above this level.

In the more practical case, there are three voltage specifications of significance, as shown in Figure 1a.

a) V_{RWM} is the maximum reverse stand-off voltage at which the Mosorb is cut off and its impedance is at its highest value — that is, the current through the device is essentially the leakage current of a back-biased diode.

b) $V_{(BR)}$ is the breakdown voltage — a voltage at which the device is entering the avalanche region, as indicated by a slight (specified) rise in current beyond the leakage current.

c) V_{RSM} is the maximum reverse voltage (clamping voltage) which is defined and specified in conjunction with the maximum reverse surge current so as not to exceed the maximum peak power rating at a pulse width (tp) of 1.0 ms (industry std time for measuring surge capability).

In practice, the Mosorb is selected so that its V_{RWM} is equal to or somewhat higher than the highest operating voltage required by the load (the circuits or components to be protected). Under normal conditions, the Mosorb is inoperative and dissipates very little power when a transient occurs, the Mosorb converts to a very low dynamic impedance and the voltage across the Mosorb becomes the clamping voltage at some level above $V_{(BR)}$. The actual clamping level will depend on the surge current through the Mosorb. The maximum reverse surge current (I_{RSM}) is specified on the Mosorb data sheets at 1.0 ms and for a logrithmically delaying pulse waveform. The data sheet also contains curves to determine the maximum surge current rating at other time intervals.

Typically, Mosorb devices have a built-in safety margin at the maximum rated surge current because the clamp voltage, V_{RSM}, is itself, guardbanded. Thus, the parts will be operating below their maximum pulse-power (P_{pk}) rating even when operated at maximum reverse surge current).

If the transients are random in nature (and in many cases they are), determining the surge-current level can be a problem. The circuit designer must make a reasonable estimate of the proper device to be used, based on his knowledge of the system and the possible transients to be encountered. (e.g., transient voltage, source impedance and time, or transient energy and time are some characteristics that must be estimated). Because of the very low dynamic impedance of Mosorb devices in the region between $V_{(BR)}$ and V_{RSM}, the maximum surge current is dependent on, and limited by the external circuitry.

In cases where this surge current is relatively low, a conventional zener diode could be used in place of a Mosorb or other dedicated protective device with some possible savings in cost. The surge capabilities of all of Motorola's zener diode lines are discussed in Motorola's Application Note AN-784A.

In the data sheets of some protective devices, the parameter for response time is emphasized. Response time on these data sheets is defined as the time required for the voltage across the protective device to rise from 0 to $V_{(BR)}$, and relates primarily to the effective series impedance associated with the device. This effective impedance is somewhat complex and changes drastically from the blocking mode to the avalanche mode. In most applications (where the protective device shunts the load) this response time parameter becomes virtually meaningless as indicated by the waveforms in Figures 1b and 1c. If the response time as defined is very long, it still would not affect the performance of the surge suppressor.

However, if the series inductance become appreciable, it could result in "overshoot" as shown in Figure 1d that would be detrimental to circuit protection. In Mosorb devices, series inductance is negligible compared to the inductive effects of the external circuitry (primarily lead lengths). Hence, Mosorbs contribute little or nothing to overshoot and, in essence, the parameter of response time has very little significance. However, care must be exercised in the design of the external circuitry to minimize overshoot.

Summary

In selecting a protective device, it is important to know as much as possible about the transient conditions to be encountered. The most important device parameters are reverse working voltage (V_{RWM}), surge current (I_{RSM}), and clamp voltage (V_{RSM}). The product of V_{RSM} and I_{RSM} yields the peak power dissipation, which is one of the prime categories for device selection.

A slector guide, in the following section, gives a broad overview of the Mosorb transient suppressors now available from Motorola. For more detailed information, please contact your Motorola sales representative or distributor.

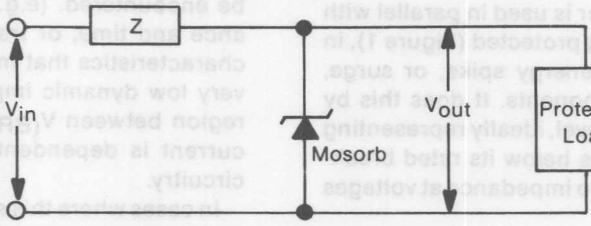


FIGURE 1

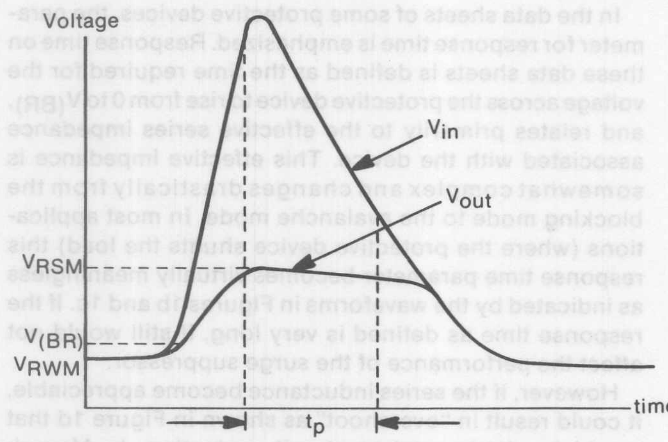


FIGURE 1a

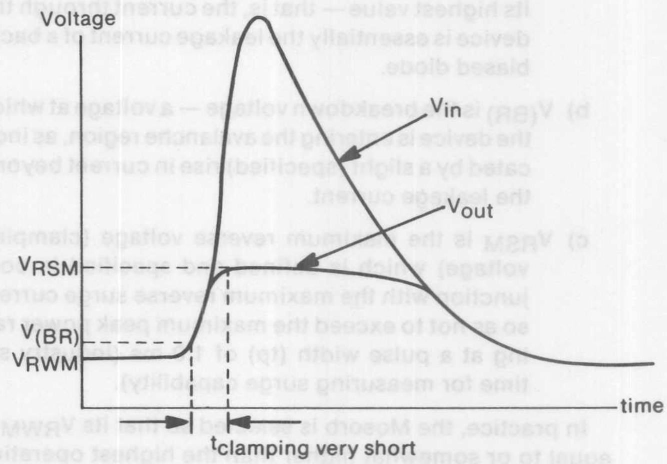


FIGURE 1b

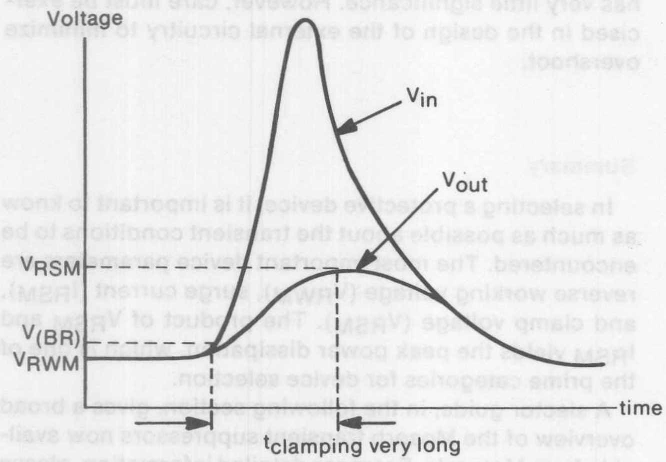


FIGURE 1c

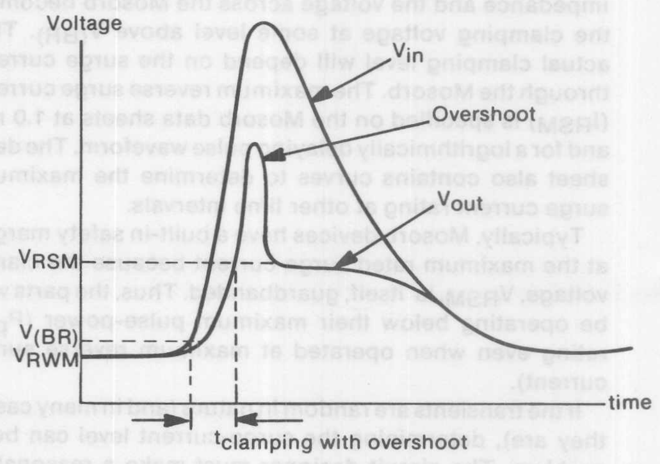


FIGURE 1d

TYPICAL MOSORB APPLICATIONS

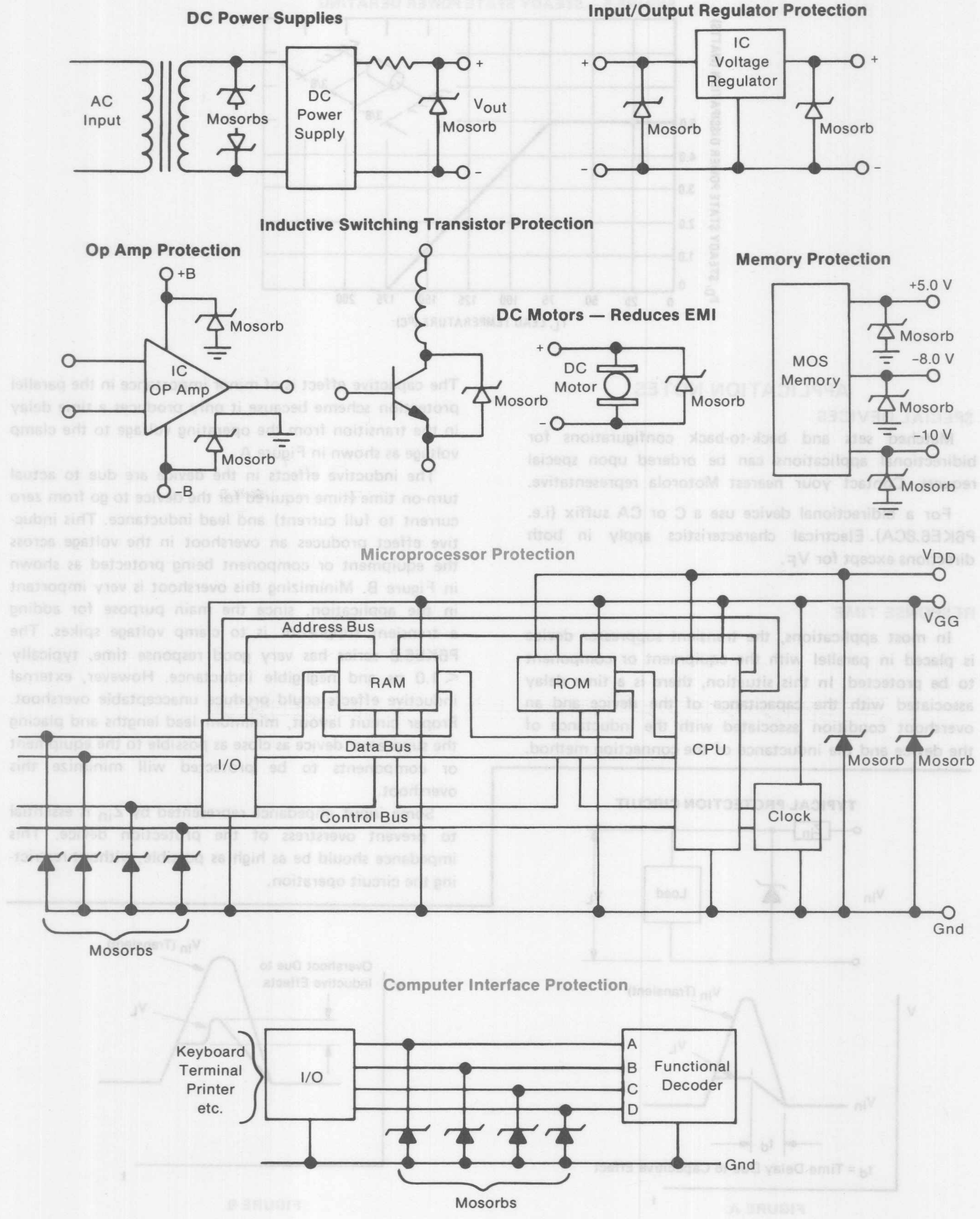
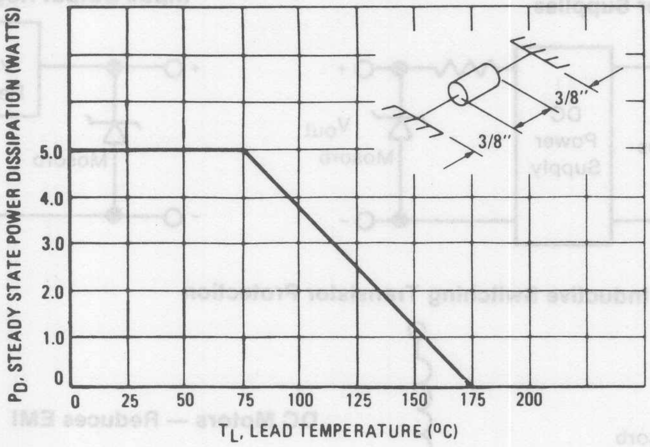


FIGURE 5 — STEADY STATE POWER DERATING



APPLICATION NOTES

SPECIAL DEVICES

Matched sets and back-to-back configurations for bidirectional applications can be ordered upon special request. Contact your nearest Motorola representative.

For a bidirectional device use a C or CA suffix (i.e. P6KE6.8CA). Electrical characteristics apply in both directions except for V_F.

RESPONSE TIME

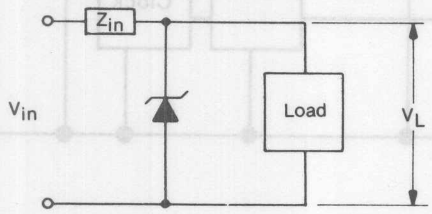
In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method.

The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure A.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure B. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The P6KE6.8 series has very good response time, typically < 1.0 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

TYPICAL PROTECTION CIRCUIT



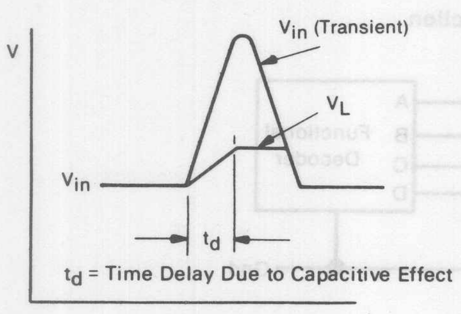


FIGURE A

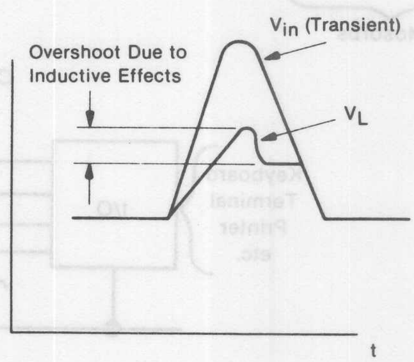


FIGURE B

TABLE 2 — Selector Guide

System DC Voltage or System Peak Voltage	600 Watts Peak Pulse Power @ 1.0 ms Surmetic 40 Case 17		1500 Watts Peak Pulse Power @ 1.0 ms Case 41						8000 Watts Peak Pulse Power @ 1.0 ms Case 19
	Unidirectional	Bidirectional	Unidirectional	Bidirectional	Unidirectional	Bidirectional	Unidirectional	Bidirectional	Unidirectional
5.0			1N5908		1N6373		ICTE-5		
6.0	P6KE6.8A		1N6267A						
6.5	P6KE7.5A	P6KE7.5CA	1N6268A	1.5KE7.5CA					
7.0	P6KE8.2A	P6KE8.2CA	1N6269A	1.5KE8.2CA					
8.0	P6KE9.1A	P6KE9.1CA	1N6270A	1.5KE9.1CA	1N6374	1N6382	ICTE-8	ICTE-8C	
8.5	P6KE10A	P6KE10CA	1N6271A	1.5KE10CA					
9.0	P6KE11A	P6KE11CA	1N6272A	1.5KE11CA					
10	P6KE12A	P6KE12CA	1N6273A	1.5KE12CA	1N6375	1N6383	ICTE-10	ICTE-10C	
11	P6KE13A	P6KE13CA	1N6274A	1.5KE13CA					
12					1N6376	1N6384	ICTE-12	ICTE-12C	
13	P6KE15A	P6KE15CA	1N6275A	1.5KE15CA					
14	P6KE16A	P6KE16CA	1N6276A	1.5KE16CA					MPZ5-16A&B
15					1N6377	1N6385	ICTE-15	ICTE-15C	
16	P6KE18A	P6KE18CA	1N6277A	1.5KE18CA					
17	P6KE20A	P6KE20CA	1N6278A	1.5KE20CA					
18	P6KE22A	P6KE22CA	1N6279A	1.5KE22CA	1N6378	1N6386	ICTE-18	ICTE-18C	
20	P6KE24A	P6KE24CA	1N6280A	1.5KE24CA					
22					1N6379	1N6387	ICTE-22	ICTE-22C	
24	P6KE27A	P6KE27CA	1N6281A	1.5KE27CA					
26	P6KE30A	P6KE30CA	1N6282A	1.5KE30CA					
28	P6KE33A	P6KE33CA	1N6283A	1.5KE33CA					MZP5-32A,B&C
30	P6KE36A	P6KE36CA	1N6284A	1.5KE36CA					
33	P6KE39A	P6KE39CA	1N6285A	1.5KE39CA					
36	P6KE43A	P6KE43CA	1N6286A	1.5KE43CA	1N6380	1N6388	ICTE-36	ICTE-36C	
40	P6KE47A	P6KE47CA	1N6287A	1.5KE47CA					
43	P6KE51A	P6KE51CA	1N6288A	1.5KE51CA					
45					1N6381	1N6389	ICTE-45	ICTE-45C	
48	P6KE56A	P6KE56CA	1N6289A	1.5KE56CA					
54	P6KE62A	P6KE62CA	1N6290A	1.5KE62CA					
58	P6KE68A	P6KE68CA	1N6291A	1.5KE68CA					
64	P6KE75A	P6KE75CA	1N6292A	1.5KE75CA					
70	P6KE82A	P6KE82CA	1N6293A	1.5KE82CA					
78	P6KE91A	P6KE91CA	1N6294A	1.5KE91CA					
85	P6KE100A	P6KE100CA	1N6295A	1.5KE100CA					
90	P6KE110A	P6KE110CA	1N6296A	1.5KE110CA					
100	P6KE120A	P6KE120CA	1N6297A	1.5KE120CA					
110	P6KE130A	P6KE130CA	1N6298A	1.5KE130CA					
120	P6KE150A	P6KE150CA	1N6299A	1.5KE150CA					
130	P6KE160A	P6KE160CA	1N6300A	1.5KE160CA					
140	P6KE170A	P6KE170CA	1N6301A	1.5KE170CA					
150	P6KE180A	P6KE180CA	1N6302A	1.5KE180CA					
165									MPZ5-180A,B,C
170	P6KE200A	P6KE200CA	1N6303A	1.5KE200CA					

MOSORBS/P6KE6.8 Series

MOTOROLA

P6KE6.8,A thru P6KE200,A

MOSORBS ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS

6.8-200 VOLT
600 WATT PEAK POWER
5.0 WATTS STEADY STATE

ZENER OVERVOLTAGE TRANSIENT SUPPRESSOR

The P6KE6.8 series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The P6KE6.8 series is supplied in Motorola's exclusive, cost-effective, highly reliable surmetic axial leaded package and is ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

SPECIFICATION FEATURES

- Standard Zener Voltage Range — 6.8 to 200 V
- Peak Power — 600 Watts @ 1.0 ms
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5.0 μA above 10 V
- Maximum Temperature Coefficient Specified

MAXIMUM RATINGS

Rating	Symbol	Value	Units
Peak Power Dissipation (1) @ $T_L \leq 25^oC$	P_{PK}	600	Watts
Steady State Power Dissipation @ $T_L \leq 75^oC$, Lead Length = 3/8″ Derated above $T_L = 75^oC$	P_D	5.0 50	Watts mW/^oC
Forward Surge Current (2) @ $T_A = 25^oC$	I_{FSM}	100	Amps
Operating and Storage Temperature Range	T_J, T_{stg}	−65 to +175	^oC

Lead Temperature not less than 1/16″ from the case for 10 seconds: 230^oC

MECHANICAL CHARACTERISTICS

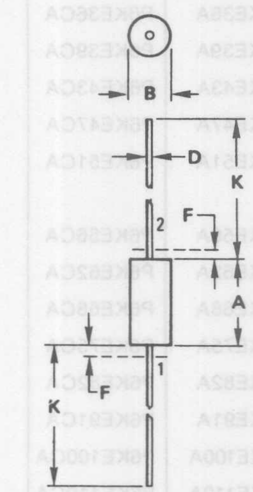
CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable and weldable

POLARITY: Cathode indicated by polarity band. When operated in zener mode, will be positive with respect to anode

MOUNTING POSITION: Any

NOTES: 1. Non-Repetitive Current Pulse per Figure 4 and Derated above $T_A = 25^oC$ per Figure 2.
2. 1/2 Square Wave (or equivalent), PW = 8.3 ms, Duty Cycle = 4 Pulses per Minute maximum.



NOTE:
1. LEAD DIAMETER & FINISH NOT CONTROLLED WITHIN DIM "F".

STYLE 1:
PIN 1. ANODE
2. CATHODE

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.38	8.89	0.330	0.350
B	3.30	3.68	0.130	0.145
D	0.94	1.09	0.037	0.043
F	–	1.27	–	0.050
K	25.40	31.75	1.000	1.250

CASE 17-02

ELECTRICAL CHARACTERISTIC (T_A = 25°C unless otherwise noted) V_F = 3.5 V max, I_F** = 50 A for all types.

Device	Breakdown Voltage * V_{BR} (Volts) Min	Nom	Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (%/°C)
P6KE6.8	6.12	6.8	7.48	10	5.50	1000	56	10.8	0.057
P6KE6.8A	6.45	6.8	7.14	10	5.80	1000	57	10.5	0.057
P6KE7.5	6.75	7.5	8.25	10	6.05	500	51	11.7	0.061
P6KE7.5A	7.13	7.5	7.88	10	6.40	500	53	11.3	0.061
P6KE8.2	7.38	8.2	9.02	10	6.63	200	48	12.5	0.065
P6KE8.2A	7.79	8.2	8.61	10	7.02	200	50	12.1	0.065
P6KE9.1	8.19	9.1	10.0	1.0	7.37	50	44	13.8	0.068
P6KE9.1A	8.65	9.1	9.55	1.0	7.78	50	45	13.4	0.068
P6KE10	9.00	10	11.0	1.0	8.10	10	40	15.0	0.073
P6KE10A	9.50	10	10.5	1.0	8.55	10	41	14.5	0.073
P6KE11	9.90	11	12.1	1.0	8.92	5.0	37	16.2	0.075
P6KE11A	10.5	11	11.6	1.0	9.40	5.0	38	15.6	0.075
P6KE12	10.8	12	13.2	1.0	9.72	5.0	35	17.3	0.078
P6KE12A	11.4	12	12.6	1.0	10.2	5.0	36	16.7	0.078
P6KE13	11.7	13	14.3	1.0	10.5	5.0	32	19.0	0.081
P6KE13A	12.4	13	13.7	1.0	11.1	5.0	33	18.2	0.081
P6KE15	13.5	15	16.5	1.0	12.1	5.0	27	22.0	0.084
P6KE15A	14.3	15	15.8	1.0	12.8	5.0	28	21.2	0.084
P6KE16	14.4	16	17.6	1.0	12.9	5.0	26	23.5	0.086
P6KE16A	15.2	16	16.8	1.0	13.6	5.0	27	22.5	0.086
P6KE18	16.2	18	19.8	1.0	14.5	5.0	23	26.5	0.088
P6KE18A	17.1	18	18.9	1.0	15.3	5.0	24	25.2	0.088
P6KE20	18.0	20	22.0	1.0	16.2	5.0	21	29.1	0.090
P6KE20A	19.0	20	21.0	1.0	17.1	5.0	22	27.7	0.090
P6KE22	19.8	22	24.2	1.0	17.8	5.0	19	31.9	0.092
P6KE22A	20.9	22	23.1	1.0	18.8	5.0	20	30.6	0.092
P6KE24	21.6	24	26.4	1.0	19.4	5.0	17	34.7	0.094
P6KE24A	22.8	24	25.2	1.0	20.5	5.0	18	33.2	0.094
P6KE27	24.3	27	29.7	1.0	21.8	5.0	15	39.1	0.096
P6KE27A	25.7	27	28.4	1.0	23.1	5.0	16	37.5	0.096
P6KE30	27.0	30	33.0	1.0	24.3	5.0	14	43.5	0.097
P6KE30A	28.5	30	31.5	1.0	25.6	5.0	14.4	41.4	0.097
P6KE33	29.7	33	36.3	1.0	26.8	5.0	12.6	47.7	0.098
P6KE33A	31.4	33	34.7	1.0	28.2	5.0	13.2	45.7	0.098
P6KE36	32.4	36	39.6	1.0	29.1	5.0	11.6	52.0	0.099
P6KE36A	34.2	36	37.8	1.0	30.8	5.0	12	49.9	0.099
P6KE39	35.1	39	42.9	1.0	31.6	5.0	10.6	56.4	0.100
P6KE39A	37.1	39	41.0	1.0	33.3	5.0	11.2	53.9	0.100
P6KE43	38.7	43	47.3	1.0	34.8	5.0	9.6	61.9	0.101
P6KE43A	40.9	43	45.2	1.0	36.8	5.0	10.1	59.3	0.101
P6KE47	42.3	47	51.7	1.0	38.1	5.0	8.9	67.8	0.101
P6KE47A	44.7	47	49.4	1.0	40.2	5.0	9.3	64.8	0.101
P6KE51	45.9	51	56.1	1.0	41.3	5.0	8.2	73.5	0.102
P6KE51A	48.5	51	53.6	1.0	43.6	5.0	8.6	70.1	0.102
P6KE56	50.4	56	61.6	1.0	45.4	5.0	7.4	80.5	0.103
P6KE56A	53.2	56	58.8	1.0	47.8	5.0	7.8	77.0	0.103
P6KE62	55.8	62	68.2	1.0	50.2	5.0	6.8	89.0	0.104
P6KE62A	58.9	62	65.1	1.0	53.0	5.0	7.1	85.0	0.104
P6KE68	61.2	68	74.8	1.0	55.1	5.0	6.1	98.0	0.104
P6KE68A	64.6	68	71.4	1.0	58.1	5.0	6.5	92.0	0.104
P6KE75	67.5	75	82.5	1.0	60.7	5.0	5.5	108.0	0.105
P6KE75A	71.3	75	78.8	1.0	64.1	5.0	5.8	103.0	0.105
P6KE82	73.8	82	90.2	1.0	66.4	5.0	5.1	118.0	0.105
P6KE82A	77.9	82	86.1	1.0	70.1	5.0	5.3	113.0	0.105
P6KE91	81.9	91	100.0	1.0	73.7	5.0	4.8	131.0	0.106
P6KE91A	86.5	91	95.50	1.0	77.8	5.0	4.8	125.0	0.106

ELECTRICAL CHARACTERISTICS (continued)

Device	Breakdown Voltage V_{BR} (Volts) Min	Nom	Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (%/°C)
P6KE100	90.0	100	110.0	1.0	81.0	5.0	4.2	144.0	0.106
P6KE100A	95.0	100	105.0	1.0	85.5	5.0	4.4	137.0	0.106
P6KE110	99.0	110	121.0	1.0	89.2	5.0	3.8	158.0	0.107
P6KE110A	105.0	110	116.0	1.0	94.0	5.0	4.0	152.0	0.107
P6KE120	108.0	120	132.0	1.0	97.2	5.0	3.5	173.0	0.107
P6KE120A	114.0	120	126.0	1.0	102.0	5.0	3.6	165.0	0.107
P6KE130	117.0	130	143.0	1.0	105.0	5.0	3.2	187.0	0.107
P6KE130A	124.0	130	137.0	1.0	111.0	5.0	3.3	179.0	0.107
P6KE150	135.0	150	165.0	1.0	121.0	5.0	2.8	215.0	0.108
P6KE150A	143.0	150	158.0	1.0	128.0	5.0	2.9	207.0	0.108
P6KE160	144.0	160	176.0	1.0	130.0	5.0	2.6	230.0	0.108
P6KE160A	152.0	160	168.0	1.0	136.0	5.0	2.7	219.0	0.108
P6KE170	153.0	170	187.0	1.0	138.0	5.0	2.5	244.0	0.108
P6KE170A	162.0	170	179.0	1.0	145.0	5.0	2.6	234.0	0.108
P6KE180	162.0	180	198.0	1.0	146.0	5.0	2.3	258.0	0.108
P6KE180A	171.0	180	189.0	1.0	154.0	5.0	2.4	246.0	0.108
P6KE200	180.0	200	220.0	1.0	162.0	5.0	2.1	287.0	0.108
P6KE200A	190.0	200	210.0	1.0	171.0	5.0	2.2	274.0	0.108

†Surge Current Waveform per Figure 4 and Derate per Figure 2.

**1/2 Square or Equivalent Sine Wave, PW = 8.3 ms, Duty Cycle = 4 Pulses per Minute maximum.

*V_{BR} measured after I_T applied for 300 μs, I_T = Square Wave Pulse or equivalent.

FIGURE 1 – PULSE RATING CURVE

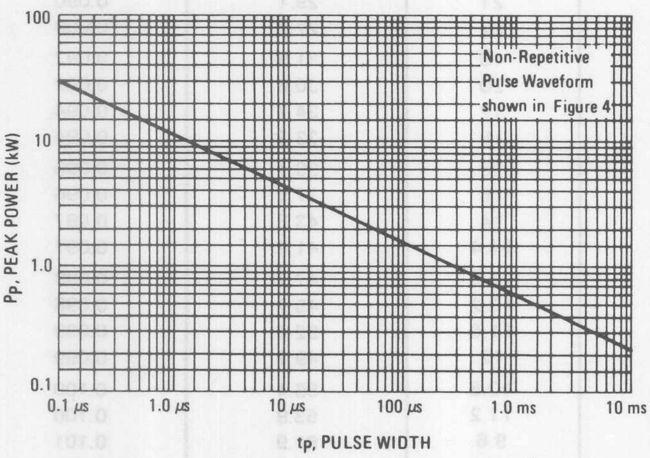


FIGURE 2 – PULSE DERATING CURVE

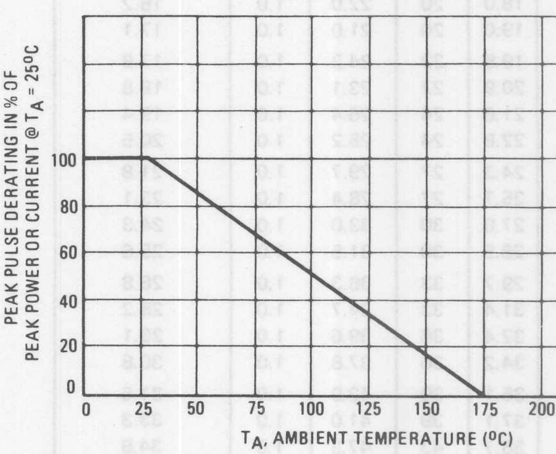


FIGURE 3 – CAPACITANCE versus BREAKDOWN VOLTAGE

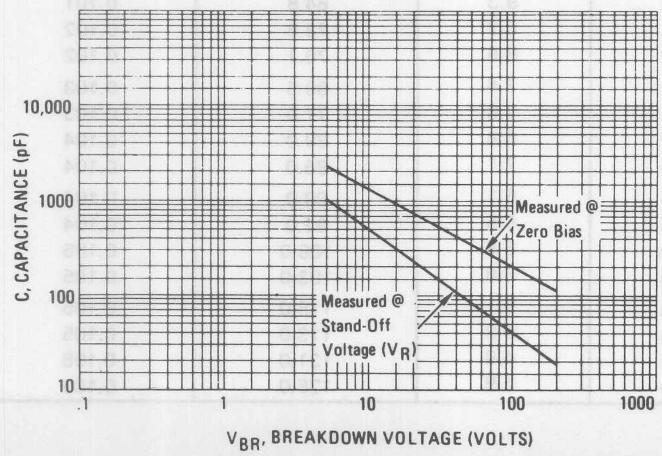
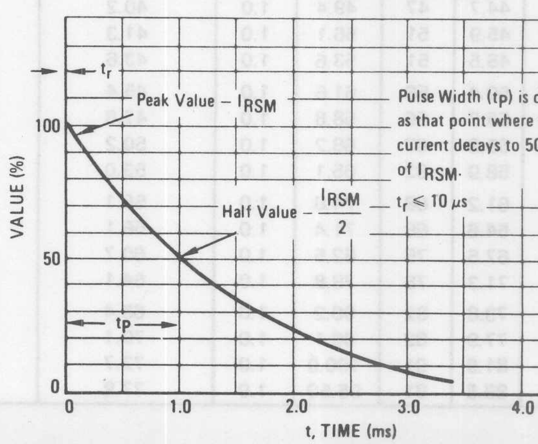


FIGURE 4 – PULSE WAVEFORM

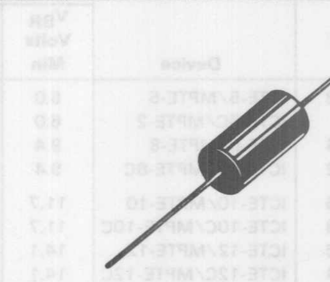


MOTOROLA

1N5908
1N6373/ICTE-5, C/MPTE-5C
thru
1N6389/ICTE-45, C/MPTE-45, C
1N6267, A/1.5KE6.8, A
thru
1N6303, A/1.5KE200, A

MOSORBS ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS

5.0-200 VOLT
1500 WATT PEAK POWER
5.0 WATTS STEADY STATE



ZENER OVERVOLTAGE TRANSIENT SUPPRESSOR

Mosorb devices are designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. These devices are Motorola's exclusive, cost-effective, highly reliable Surmetic axial leaded package and are ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications, to protect CMOS, MOS and Bipolar integrated circuits.

SPECIFICATION FEATURES

- Standard Voltage Range — 5.0 to 200 V
- Peak Power — 1500 Watts @ 1.0 ms
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5.0 μA above 10 V
- Standard Back to Back Versions Available

MAXIMUM RATINGS

Rating	Symbol	Value	Units
Peak Power Dissipation (1) @ $T_L \leq 25^oC$	P_{PK}	1500	Watts
Steady State Power Dissipation @ $T_L \leq 75^oC$, Lead Length = 3/8" Derated above $T_L = 75^oC$	P_D	5.0 50	Watts mW/^{o}C
Forward Surge Current (2) @ $T_A = 25^oC$	I_{FSM}	200	Amps
Operating and Storage Temperature Range	T_J, T_{stg}	-65 to +175	^{o}C

Lead Temperature not less than 1/16" from the case for 10 seconds: 230°C

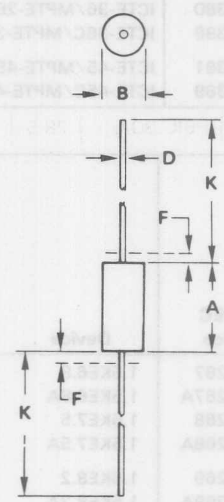
MECHANICAL CHARACTERISTICS

CASE: Void-free, transfer-molded, thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable and weldable

POLARITY: Cathode indicated by polarity band. When operated in zener mode, will be positive with respect to anode

MOUNTING POSITION: Any



NOTE:
1. LEAD FINISH AND DIA UNCONTROLLED IN AREA "F".

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.14	9.52	0.360	0.375
B	4.83	5.21	0.190	0.205
D	0.97	1.07	0.038	0.042
F	–	1.27	–	0.050
K	27.94	–	1.100	–

CASE 41-11

NOTES:
1. Nonrepetitive Current Pulse per Figure 4 and Derated above $T_A = 25^oC$ per Figure 2.
2. 1/2 Square Wave (or equivalent), PW = 8.3 ms, Duty Cycle = 4 Pulses per minute maximum.

*ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F# = 3.5 V max, I_F** = 100 A

Device	Breakdown Voltage V_{BR} (Volts) Min	Breakdown Voltage @ I_T (mA)	Maximum Reverse Stand-Off Voltage V_{RWM}*** (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Voltage @ I_{RSM}† = 120 A (Clamping Voltage) V_{RSM} (Volts)	Clamping Voltage: Peak Pulse Current @ I_{pp1}† = 30 A V_{C1} (Volts max)	Clamping Voltage: Peak Pulse Current @ I_{pp2}† = 60 A V_{C2} (Volts max)
1N5908	6.0	1.0	5.0	300	8.5	7.6	8.0

.LECTRICAL CHARACTERISTIC (T_A = 25°C unless otherwise noted) V_F# = 3.5 V max, I_F** = 100 A) (C suffix denotes standard back to back versions. Test both polarities)

JEDEC Device	Device	Breakdown Voltage V_{BR} Volts Min	Breakdown Voltage @ I_T (mA)	Maximum Reverse Stand-Off Voltage V_{RWM}*** (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM}† (Clamping Voltage) V_{RSM} (Volts)	Clamping Voltage: Peak Pulse Current @ I_{pp1}† = 1.0 A V_{C1} (Volts max)	Clamping Voltage: Peak Pulse Current @ I_{pp2}† = 10 A V_{C2} (Volts max)
1N6373	ICTE-5/MPTE-5	6.0	1.0	5.0	300	160	9.4	7.1	7.5
—	ICTE-5C/MPTE-2	6.0	1.0	5.0	300	160	9.4	8.1	8.3
1N6374	ICTE-8/MPTE-8	9.4	1.0	8.0	25	100	15.0	11.3	11.5
1N6382	ICTE-8C/MPTE-8C	9.4	1.0	8.0	25	100	15.0	11.4	11.6
1N6375	ICTE-10/MPTE-10	11.7	1.0	10	2.0	90	16.7	13.7	14.1
1N6383	ICTE-10C/MPTE-10C	11.7	1.0	10	2.0	90	16.7	14.1	14.5
1N6376	ICTE-12/MPTE-12	14.1	1.0	12	2.0	70	21.2	16.1	16.5
1N6384	ICTE-12C/MPTE-12C	14.1	1.0	12	2.0	70	21.2	16.7	17.1
1N6377	ICTE-15/MPTE-15	17.6	1.0	15	2.0	60	25.0	20.1	20.6
1N6385	ICTE-15C/MPTE-15C	17.6	1.0	15	2.0	60	25.0	20.8	21.4
1N6378	ICTE-18/MPTE-18	21.2	1.0	18	2.0	50	30.0	24.2	25.2
1N6386	ICTE-18C/MPTE-18C	21.2	1.0	18	2.0	50	30.0	24.8	25.5
1N6379	ICTE-22/MPTE-22	25.9	1.0	22	2.0	40	37.5	29.8	32.0
1N6387	ICTE-22C/MPTE-22C	25.9	1.0	22	2.0	40	37.5	30.8	32.0
1N6380	ICTE-36/MPTE-26	42.4	1.0	36	2.0	23	65.2	50.6	54.3
1N6388	ICTE-36C/MPTE-36C	42.4	1.0	36	2.0	23	65.2	50.6	54.3
1N6381	ICTE-45/MPTE-45	52.9	1.0	45	2.0	19	78.9	63.3	70.0
1N6389	ICTE-45C/MPTE-45C	52.9	1.0	45	2.0	19	78.9	63.3	70.0

JEDEC Device	Device	Breakdown Voltage V_{BR} Volts Min	Breakdown Voltage V_{BR} Volts Nom	Breakdown Voltage V_{BR} Volts Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (%/°C)
1N6267	1.5KE6.8	6.12	6.8	7.48	10	5.50	1000	139	10.8	0.057
1N6267A	1.5KE6.8A	6.45	6.8	7.14	10	5.80	1000	143	10.5	0.057
1N6268	1.5KE7.5	6.75	7.5	8.25	10	6.05	500	128	11.7	0.061
1N6268A	1.5KE7.5A	7.13	7.5	7.88	10	6.40	500	132	11.3	0.061
1N6269	1.5KE8.2	7.38	8.2	9.02	10	6.63	200	120	12.5	0.065
1N6269A	1.5KE8.2A	7.79	8.2	8.61	10	7.02	200	124	12.1	0.065
1N6270	1.5KE9.1	8.19	9.1	10.0	1.0	7.37	50	109	13.8	0.068
1N6270A	1.5KE9.1A	8.65	9.1	9.55	1.0	7.78	50	112	13.4	0.068
1N6271	1.5KE10	9.00	10	11	1.0	8.10	10	100	15.0	0.073
1N6271A	1.5KE10A	9.50	10	10.5	1.0	8.55	10	103	14.5	0.073
1N6272	1.5KE11	9.90	11	12.1	1.0	8.92	5.0	93.0	16.2	0.075
1N6272A	1.5KE11A	10.5	11	11.6	1.0	9.40	5.0	96.0	15.6	0.075

*ELECTRICAL CHARACTERISTICS (Continued)

JEDEC Device	Device	Breakdown Voltage V_{BR} Volts Min	Nom	Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (%/°C)
1N6273	1.5KE12	10.8	12	13.2	1.0	9.72	5.0	87.0	17.3	0.078
1N6273A	1.5KE12A	11.4	12	12.6	1.0	10.2	5.0	90.0	16.7	0.078
1N6274	1.5KE13	11.7	13	14.3	1.0	10.5	5.0	79.0	19.0	0.081
1N6274A	1.5KE13A	12.4	13	13.7	1.0	11.1	5.0	82.0	18.2	0.081
1N6275	1.5KE15	13.5	15	16.5	1.0	12.1	5.0	68.0	22.0	0.084
1N6275A	1.5KE15A	14.3	15	15.8	1.0	12.8	5.0	71.0	21.2	0.084
1N6276	1.5KE16	14.4	16	17.6	1.0	12.9	5.0	64.0	23.5	0.086
1N6276A	1.5KE16A	15.2	16	16.8	1.0	13.6	5.0	67.0	22.5	0.086
1N6277	1.5KE18	16.2	18	19.8	1.0	14.5	5.0	56.5	26.5	0.088
1N6277A	1.5KE18A	17.1	18	18.9	1.0	15.3	5.0	59.5	25.2	0.088
1N6278	1.5KE20	18.0	20	22.0	1.0	16.2	5.0	51.5	29.1	0.090
1N6278A	1.5KE20A	19.0	20	21.0	1.0	17.1	5.0	54.0	27.7	0.090
1N6279	1.5KE22	19.8	22	24.2	1.0	17.8	5.0	47.0	31.9	0.092
1N6279A	1.5KE22A	20.9	22	23.1	1.0	18.8	5.0	49.0	30.6	0.092
1N6280	1.5KE24	21.6	24	26.4	1.0	19.4	5.0	43.0	34.7	0.094
1N6280A	1.5KE24A	22.8	24	25.2	1.0	20.5	5.0	45.0	33.2	0.094
1N6281	1.5KE27	24.3	27	29.7	1.0	21.8	5.0	38.5	39.1	0.096
1N6281A	1.5KE27A	25.7	27	28.4	1.0	23.1	5.0	40.0	37.5	0.096
1N6282	1.5KE30	27.0	30	33.0	1.0	24.3	5.0	34.5	43.5	0.097
1N6282A	1.5KE30A	28.5	30	31.5	1.0	25.6	5.0	36.0	41.4	0.097
1N6283	1.5KE33	29.7	33	36.3	1.0	26.8	5.0	31.5	47.7	0.098
1N6283A	1.5KE33A	31.4	33	34.7	1.0	28.2	5.0	33.0	45.7	0.098
1N6284	1.5KE36	32.4	36	39.6	1.0	29.1	5.0	29.0	52.0	0.099
1N6284A	1.5KE36A	34.2	36	37.8	1.0	30.8	5.0	30.0	49.9	0.099
1N6285	1.5KE39	35.1	39	42.9	1.0	31.6	5.0	26.5	56.4	0.100
1N6285A	1.5KE39A	37.1	39	41.0	1.0	33.3	5.0	28.0	53.9	0.100
1N6286	1.5KE43	38.7	43	47.3	1.0	34.8	5.0	24.0	61.9	0.101
1N6286A	1.5KE43A	40.9	43	45.2	1.0	36.8	5.0	25.3	59.3	0.101
1N6287	1.5KE47	42.3	47	51.7	1.0	38.1	5.0	22.2	67.8	0.101
1N6287A	1.5KE47A	44.7	47	49.4	1.0	40.2	5.0	23.2	64.8	0.101
1N6288	1.5KE51	45.9	51	56.1	1.0	41.3	5.0	20.4	73.5	0.102
1N6288A	1.5KE51A	48.5	51	53.6	1.0	43.6	5.0	21.4	70.1	0.102
1N6289	1.5KE56	50.4	56	61.6	1.0	45.4	5.0	18.6	80.5	0.103
1N6289A	1.5KE56A	53.2	56	58.8	1.0	47.8	5.0	19.5	77.0	0.103
1N6290	1.5KE62	55.8	62	68.2	1.0	50.2	5.0	16.9	89.0	0.104
1N6290A	1.5KE62A	58.9	62	65.1	1.0	53.0	5.0	17.7	85.0	0.104
1N6291	1.5KE68	61.2	68	74.8	1.0	55.1	5.0	15.3	98.0	0.104
1N6291A	1.5KE68A	64.6	68	71.4	1.0	58.1	5.0	16.3	92.0	0.104
1N6292	1.5KE75	67.5	75	82.5	1.0	60.7	5.0	13.9	108.0	0.105
1N6292A	1.5KE75A	71.3	75	78.8	1.0	64.1	5.0	14.6	103.0	0.105
1N6293	1.5KE82	73.8	82	90.2	1.0	66.4	5.0	12.7	118.0	0.105
1N6293A	1.5KE82A	77.9	82	86.1	1.0	70.1	5.0	13.3	113.0	0.105
1N6294	1.5KE91	81.9	91	100.0	1.0	73.7	5.0	11.4	131.0	0.106
1N6294A	1.5KE91A	86.5	91	95.50	1.0	77.8	5.0	12.0	125.0	0.106

†Surge Current Waveform per Figure 4 and Derate per Figure 2.

*Indicates JEDEC Registered Data.

**1/2 Square or Equivalent Sine Wave, PW = 8.3 ms, Duty Cycle = 4 Pulses per Minute maximum.

***A Transient Suppressor is normally selected according to the maximum reverse stand-off voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.

#V_F applies to Non-C suffix devices only.

C suffix denotes standard back-to-back versions. Test both polarities.

To order clipper bidirectional device, add a "C" suffix to 1.5KE device title; i.e., 1.5KE7.5C or 1.5KE7.5CA.

*ELECTRICAL CHARACTERISTICS (Continued)

JEDEC Device	Device	Breakdown Voltage V_{BR} Volts Min	Nom	Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clampling Voltage) V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (%/°C)
1N6295	1.5KE100	90.0	100	110.0	1.0	81.0	5.0	10.4	144.0	0.106
1N6295A	1.5KE100A	95.0	100	105.0	1.0	85.5	5.0	11.0	137.0	0.106
1N6296	1.5KE110	99.0	110	121.0	1.0	89.2	5.0	9.5	158.0	0.107
1N6296A	1.5KE110A	105.0	110	116.0	1.0	94.0	5.0	9.9	152.0	0.107
1N6297	1.5KE120	108.0	120	132.0	1.0	97.2	5.0	8.7	173.0	0.107
1N6297A	1.5KE120A	114.0	120	126.0	1.0	102.0	5.0	9.1	165.0	0.107
1N6298	1.5KE130	117.0	130	143.0	1.0	105.0	5.0	8.0	187.0	0.107
1N6298A	1.5KE130A	124.0	130	137.0	1.0	111.0	5.0	8.4	179.0	0.107
1N6299	1.5KE150	135.0	150	165.0	1.0	121.0	5.0	7.0	215.0	0.108
1N6299A	1.5KE150A	143.0	150	158.0	1.0	128.0	5.0	7.2	207.0	0.108
1N6300	1.5KE160	144.0	160	176.0	1.0	130.0	5.0	6.5	230.0	0.108
1N6300A	1.5KE160A	152.0	160	168.0	1.0	136.0	5.0	6.8	219.0	0.108
1N6301	1.5KE170	153.0	170	187.0	1.0	138.0	5.0	6.2	244.0	0.108
1N6301A	1.5KE170A	162.0	170	179.0	1.0	145.0	5.0	6.4	234.0	0.108
1N6302	1.5KE180	162.0	180	198.0	1.0	146.0	5.0	5.8	258.0	0.108
1N6302A	1.5KE180A	171.0	180	189.0	1.0	154.0	5.0	6.1	246.0	0.108
1N6303	1.5KE200	180.0	200	220.0	1.0	162.0	5.0	5.2	287.0	0.108
1N6303A	1.5KE200A	190.0	200	210.0	1.0	171.0	5.0	5.5	274.0	0.108

†Surge Current Waveform per Figure 4 and Derate per Figure 2.

*Indicates JEDEC Registered Data.

**1/2 Square Equivalent Sine Wave, PW = 8.3 ms, Duty Cycle = 4 Pulses per Minute maximum.

To order clipper-bidirectional device add a "C" suffix to 1.5KE device title, i.e., 1.5KE7.5C or 1.5KE7.5CA.

FIGURE 1 — PULSE RATING CURVE

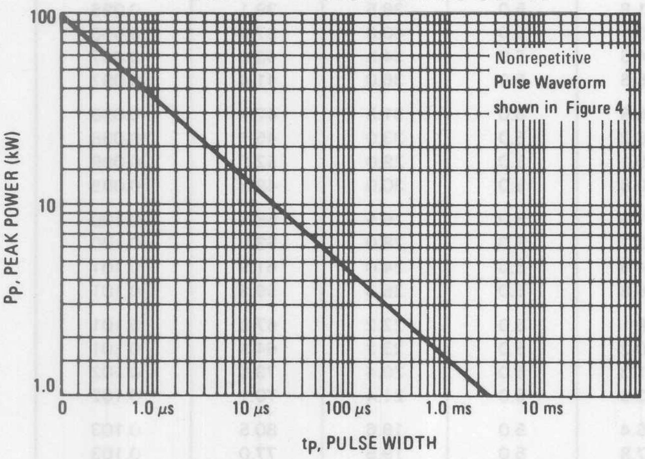


FIGURE 2 — PULSE DERATING CURVE

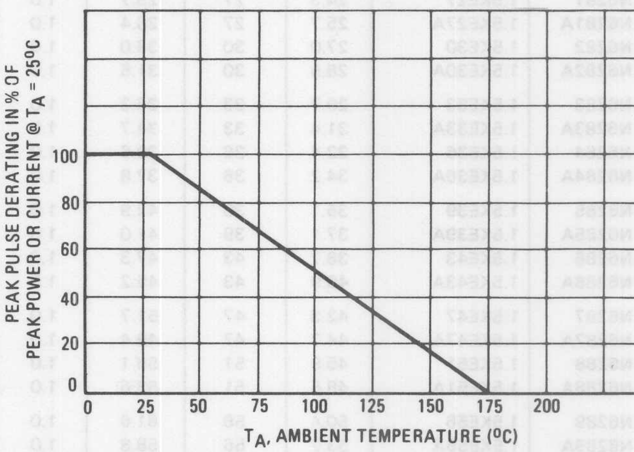


FIGURE 3 — CAPACITANCE versus BREAKDOWN VOLTAGE

1N6373, ICTE-5, C, MPTE-5, C
thru
1N6389, ICTE-45, C, MPTE-45, C

1N6267, A/1.5KE6.8, A
thru
1N6303, A/1.5KE200, A

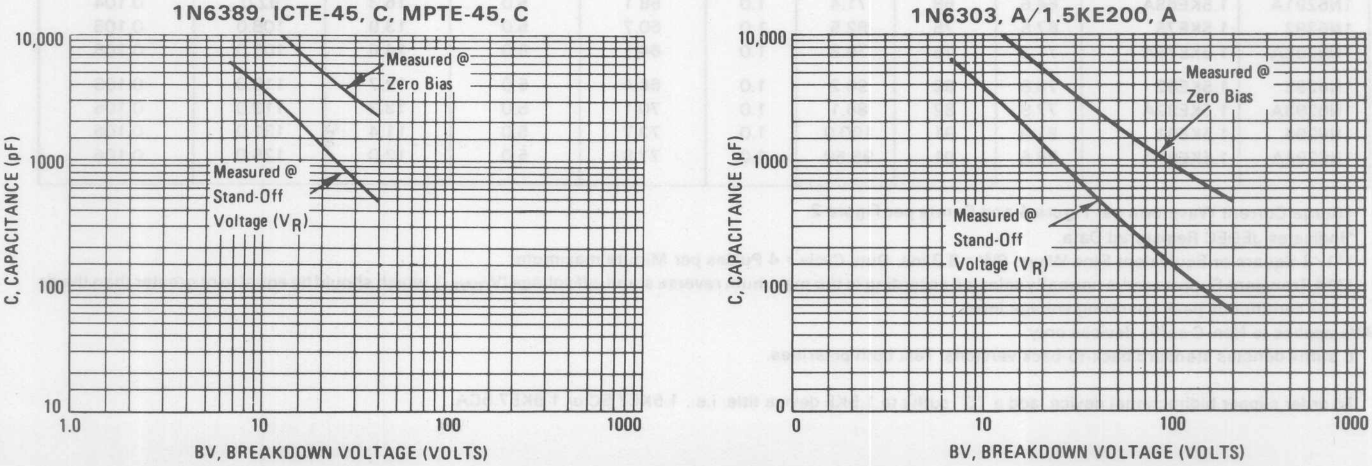


FIGURE 4 — STEADY STATE POWER DERATING

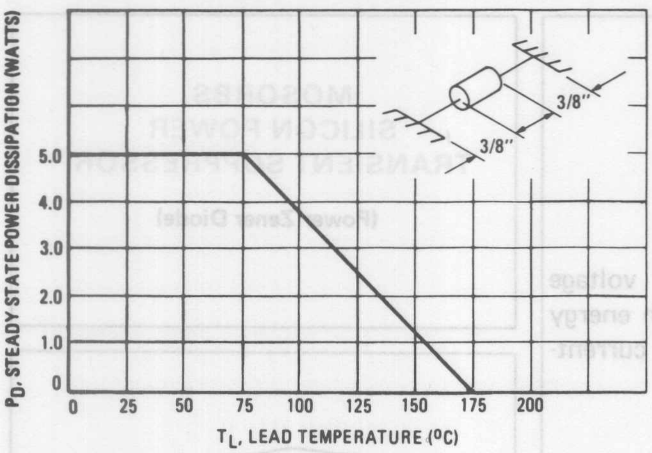


FIGURE 5 — PULSE WAVEFORM

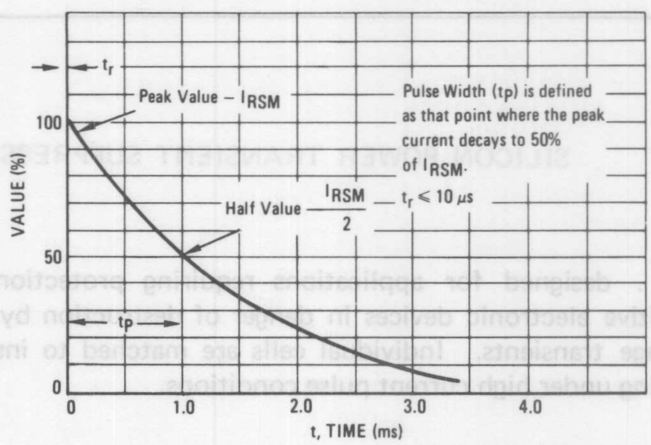
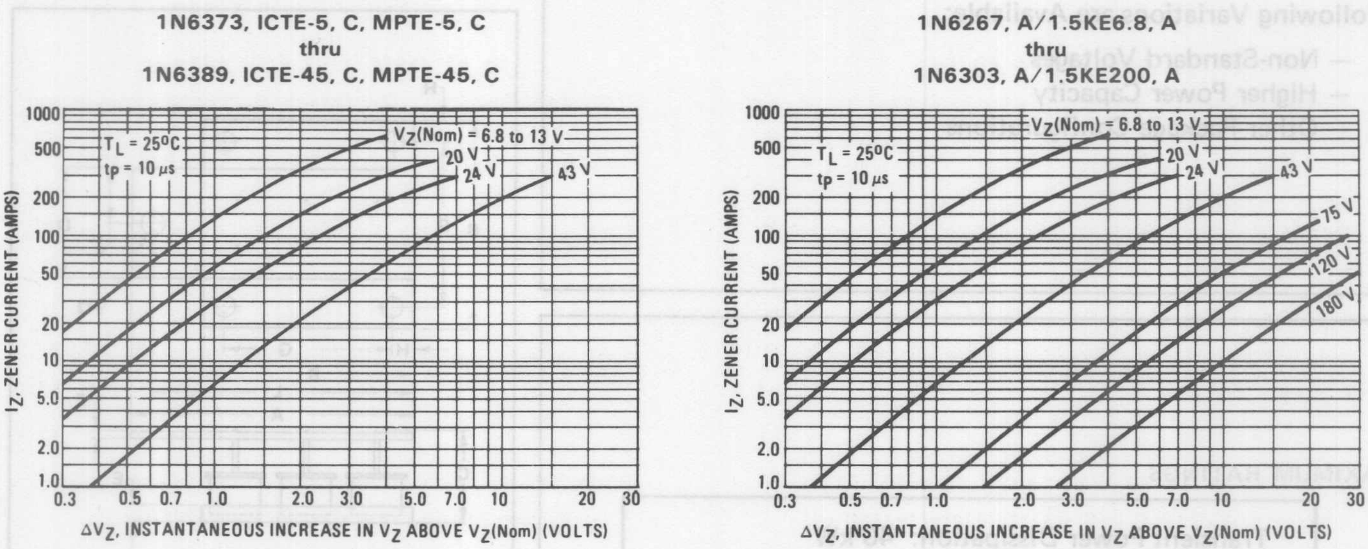


FIGURE 6 — DYNAMIC IMPEDANCE



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MPZ5-16 series
MPZ5-32 series
MPZ5-180 series

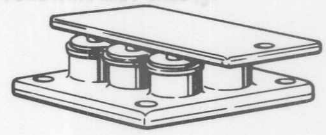
SILICON POWER TRANSIENT SUPPRESSOR

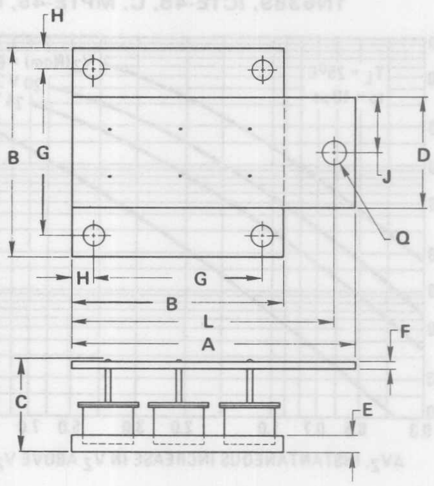
. . . designed for applications requiring protection of voltage sensitive electronic devices in danger of destruction by high energy voltage transients. Individual cells are matched to insure current-sharing under high current pulse conditions.

- Peak Surge Power Capacity Given From 0.1 ms To 10 Seconds
- Low Clamping Factor Assures Low Voltage Overshoot
- Negligible Power Loss
- Small Size and Weight
- Following Variations are Available:
  - Non-Standard Voltages
  - Higher Power Capacity
  - Other Package Configurations

MOSORBS
SILICON POWER
TRANSIENT SUPPRESSOR

(Power Zener Diode)





NOTE: DIA "Q" 5 PLACES

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	50.29	51.31	1.980	2.020
B	37.59	38.61	1.480	1.520
C	–	16.51	–	0.650
D	20.24	21.01	0.797	0.827
E	2.92	3.43	0.115	0.135
F	1.32	1.83	0.052	0.072
G	29.97	30.99	1.180	1.220
H	3.56	4.06	0.140	0.160
J	10.06	10.57	0.396	0.416
L	46.74	47.74	1.840	1.860
Q	3.30	3.81	0.130	0.150

CASE 119-01

MAXIMUM RATINGS

Transient Power Dissipation: 40 kW
Pulse Width: 0.1 ms, (See Figure 1)

DC Power Dissipation: 350 Watts @ $T_C = 25°C$
(Derate 2.33 W/°C above 25°C)

Operating Junction & Storage Temperature
Range: −65°C to +175°C

Polarity:
Anode-to-Case is Standard
Cathode-to-Case Available Upon Request

ELECTRICAL CHARACTERISTICS ($T_A = 25^oC$) (V_F = 1.5 V max @ 10 A for all types)

Type	Nominal Operating Voltage (Note 1) $V_{OP(PK)}$ Vdc	$V_{OP(RMS)}$ V rms	Maximum Device Clamping Factor $CF = \frac{V_Z @ I_{Z(pulse)}}{V_Z @ I_{ZT}}$ (Note 2)	Minimum Zener Voltage $V_{Z(min)}$ Vdc	@	I_{ZT} Adc	Maximum Zener Voltage Pulse Width = 1.0 ms $V_{Z(max)}$ Vdc	@	$I_{Z(pulse)}$ Adc	Maximum Reverse Current $I_{R(max)}$ @ $V_R = V_{OP(PK)}$ µAdc	Typical Capacitance C (typ) @ $V_R = V_{OP(PK)}$ µF
MPZ5-16A	14	10	1.25	16		0.4	24		200	50	0.025
-16B	14	10	1.25	16		0.4	20		200		0.025
-32A	28	20	1.25	32		0.2	50		100		0.011
-32B	28	20	1.25	32		0.2	45		100		0.011
-32C	28	20	1.25	32		0.2	40		100		0.011
-180A	165	117	1.14	180		0.03	250		20		0.0012
-180B	165	117	1.14	180		0.03	225		20		0.0012
-180C	165	117	1.14	180		0.03	205		20	50	0.0012

FIGURE 1 – MAXIMUM NON-REPETITIVE SURGE POWER
(RECTANGULAR WAVEFORM)

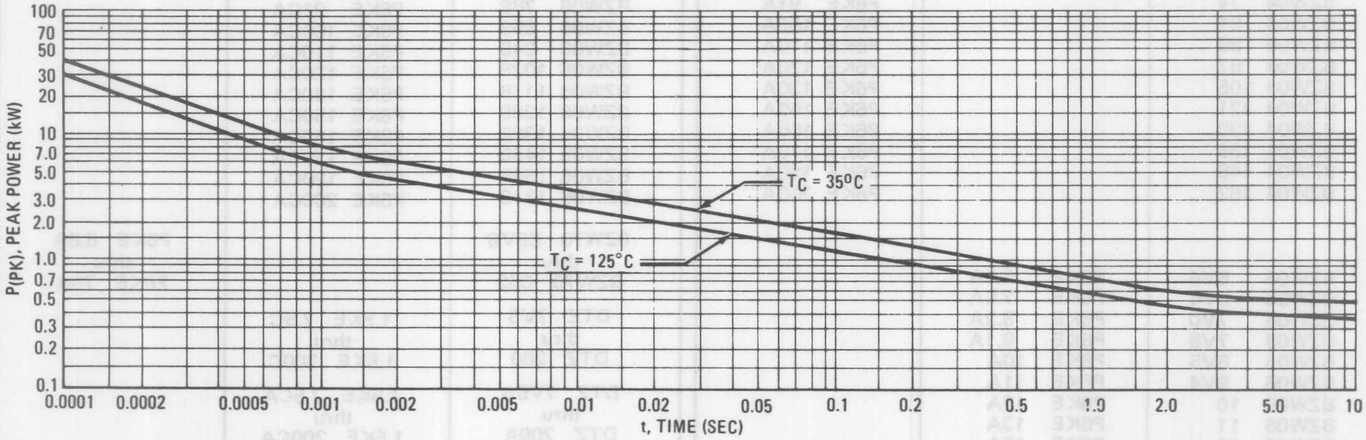
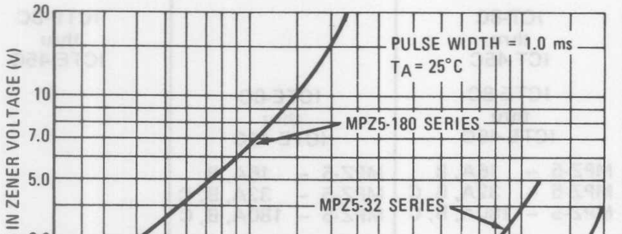


FIGURE 2 – TYPICAL DYNAMIC ZENER VOLTAGE CHARACTERISTICS (Note 2)



NOTE 1: Nominal operating voltage is defined as normal input voltage to device for non-operating condition. If non-sinusoidal wave or dc input is present, peak voltage input values $V_{OP(PK)}$ should be used to select device type.

NOTE 2: The maximum device clamping factor C_F is a ratio of V_Z measured at I_Z (pulse) given in the Electrical Characteristics Table divided by V_Z measured at I_{ZT} under steady state conditions. This value guarantees the sharpness of the voltage breakdown of individual devices. Figure 2 demonstrates the typical sharpness of the breakdown, and indicates the voltage regulation over a wide range of currents.

$$\Delta V_Z = V_Z @ I_{Z(pulse)} - V_Z @ I_{ZT}$$

TABLE 3 – CROSS–REFERENCE

Industry Part Number	MOTOROLA Direct Replacement	MOTOROLA Similar Replacement
BZW04 5V5		P6KE 6.8A
BZW04 6V0		P6KE 7.5A
BZW04 6V6		P6KE 8.2A
BZW04 7V4		P6KE 9.1A
BZW04 8V1		P6KE 10A
BZW04 8V9		P6KE 11A
BZW04 9V7		P6KE 12A
BZW04 10		P6KE 13A
BZW04 12		P6KE 15A
BZW04 13		P6KE 16A
BZW04 14		P6KE 18A
BZW04 16		P6KE 20A
BZW04 18		P6KE 22A
BZW04 19		P6KE 24A
BZW04 22		P6KE 27A
BZW04 24		P6KE 30A
BZW04 27		P6KE 33A
BZW04 29		P6KE 36A
BZW04 32		P6KE 39A
BZW04 35		P6KE 43A
BZW04 38		P6KE 47A
BZW04 41		P6KE 51A
BZW04 45		P6KE 56A
BZW04 50		P6KE 62A
BZW04 55		P6KE 68A
BZW04 61		P6KE 75A
BZW04 66		P6KE 82A
BZW04 74		P6KE 91A
BZW04 81		P6KE 100A
BZW04 89		P6KE 110A
BZW04 97		P6KE 120A
BZW04 105		P6KE 130A
BZW04 121		P6KE 150A
BZW04 130		P6KE 160A
BZW04 138		P6KE 170A
BZW04 146		P6KE 180A
BZW04 162		P6KE 200A
BZW06 5V8	P6KE 6.8A	
BZW06 6V4	P6KE 7.5A	
BZW06 7V0	P6KE 8.2A	
BZW06 7V8	P6KE 9.1A	
BZW06 8V5	P6KE 10A	
BZW06 9V4	P6KE 11A	
BZW06 10	P6KE 12A	
BZW06 11	P6KE 13A	
BZW06 13	P6KE 15A	
BZW06 14	P6KE 16A	
BZW06 15	P6KE 18A	
BZW06 17	P6KE 20A	
BZW06 19	P6KE 22A	
BZW06 20	P6KE 24A	
BZW06 23	P6KE 27A	
BZW06 26	P6KE 30A	
BZW06 28	P6KE 33A	
BZW06 31	P6KE 36A	
BZW06 33	P6KE 39A	
BZW06 37	P6KE 43A	
BZW06 40	P6KE 47A	
BZW06 44	P6KE 51A	
BZW06 48	P6KE 56A	
BZW06 53	P6KE 62A	
BZW06 58	P6KE 68A	
BZW06 64	P6KE 75A	
BZW06 70	P6KE 82A	
BZW06 78	P6KE 91A	
BZW06 85	P6KE 100A	
BZW06 94	P6KE 110A	
BZW06 102	P6KE 120A	
BZW06 111	P6KE 130A	
BZW06 128	P6KE 150A	
BZW06 136	P6KE 160A	
BZW06 145	P6KE 170A	
BZW06 154	P6KE 180A	
BZW06 171	P6KE 200A	

Industry Part Number	MOTOROLA Direct Replacement	MOTOROLA Similar Replacement
BZW06 5V8B	P6KE 6.8CA	
BZW06 6V4B	P6KE 7.5CA	
BZW06 7V0B	P6KE 8.2CA	
BZW06 7V8B	P6KE 9.1CA	
BZW06 8V5B	P6KE 10CA	
BZW06 9V4B	P6KE 11CA	
BZW06 10B	P6KE 12CA	
BZW06 11B	P6KE 13CA	
BZW06 13B	P6KE 15CA	
BZW06 14B	P6KE 16CA	
BZW06 15B	P6KE 18CA	
BZW06 17B	P6KE 20CA	
BZW06 19B	P6KE 22CA	
BZW06 20B	P6KE 24CA	
BZW06 23B	P6KE 27CA	
BZW06 26B	P6KE 30CA	
BZW06 28B	P6KE 33CA	
BZW06 31B	P6KE 36CA	
BZW06 33B	P6KE 39CA	
BZW06 37B	P6KE 43CA	
BZW06 40B	P6KE 47CA	
BZW06 44B	P6KE 51CA	
BZW06 48B	P6KE 56CA	
BZW06 53B	P6KE 62CA	
BZW06 58B	P6KE 68CA	
BZW06 64B	P6KE 75CA	
BZW06 70B	P6KE 82CA	
BZW06 78B	P6KE 91CA	
BZW06 85B	P6KE 100CA	
BZW06 94B	P6KE 110CA	
BZW06 102B	P6KE 120CA	
BZW06 111B	P6KE 130CA	
BZW06 128B	P6KE 150CA	
BZW06 136B	P6KE 160CA	
BZW06 145B	P6KE 170CA	
BZW06 154B	P6KE 180CA	
BZW06 171B	P6KE 200CA	
BZW70 C5V6 thru BZW70 C62		P6KE 6.8A thru P6KE 75A
DTZ 7V5 thru DTZ 200	1.5KE 7.5C thru 1.5KE 200C	
DTZ 7V5A thru DTZ 200A	1.5KE 7.5CA thru 1.5KE 200CA	
ICT-5 thru ICT-45		ICTE-5 thru ICTE-45
ICTE-5 thru ICTE-45	ICTE-5 thru ICTE-45	
ICT-8C thru ICT-45C		ICTE-8C thru ICTE-45C
ICTE-8C thru ICTE-45C	ICTE-8C thru ICTE-45C	
MPZ-5 – 16A, B	MPZ-5 – 16A, B	
MPZ-5 – 32A, B, C	MPZ-5 – 32A, B, C	
MPZ-5 – 180A, B, C	MPZ-5 – 180A, B, C	
MPT-5 thru MPT-45		MPTE-5 thru MPTE-45
MPTE-5 thru MPTE-45	MPTE-5 thru MPTE-45	
MPT-8C thru MPT-45C		MPTE-8C thru MPTE-45C
MPTE-8C thru MPTE-45C	MPTE-8C thru MPTE-45C	

Industry Part Number	MOTOROLA Direct Replacement	MOTOROLA Similar Replacement
PFZ 6V8	1N6267	
PFZ 6V8A	1N6267A	
PFZ 7V5	1N6268	
PFZ 7V5A	1N6268A	
PFZ 8V2	1N6269	
PFZ 8V2A	1N6269A	
PFZ 9V1	1N6270	
PFZ 9V1A	1N6270A	
PFZ 10	1N6271	
PFZ 10A	1N6271A	
PFZ 11	1N6272	
PFZ 11A	1N6272A	
PFZ 12	1N6273	
PFZ 12A	1N6273A	
PFZ 13	1N6274	
PFZ 13A	1N6274A	
PFZ 15	1N6275	
PFZ 15A	1N6275A	
PFZ 16	1N6276	
PFZ 16A	1N6276A	
PFZ 18	1N6277	
PFZ 18A	1N6277A	
PFZ 20	1N6278	
PFZ 20A	1N6278A	
PFZ 22	1N6279	
PFZ 22A	1N6279A	
PFZ 24	1N6280	
PFZ 24A	1N6280A	
PFZ 27	1N6281	
PFZ 27A	1N6281A	
PFZ 30	1N6282	
PFZ 30A	1N6282A	
PFZ 33	1N6283	
PFZ 33A	1N6283A	
PFZ 36	1N6284	
PFZ 36A	1N6284A	
PFZ 39	1N6285	
PFZ 39A	1N6285A	
PFZ 43	1N6286	
PFZ 43A	1N6286A	
PFZ 47	1N6287	
PFZ 47A	1N6287A	
PFZ 51	1N6288	
PFZ 51A	1N6288A	
PFZ 56	1N6289	
PFZ 56A	1N6289A	
PFZ 62	1N6290	
PFZ 62A	1N6290A	
PFZ 68	1N6291	
PFZ 68A	1N6291A	
PFZ 75	1N6292	
PFZ 75A	1N6292A	
PFZ 82	1N6293	
PFZ 82A	1N6293A	
PFZ 91	1N6294	
PFZ 91A	1N6294A	
PFZ 100	1N6295	
PFZ 100A	1N6295A	
PFZ 110	1N6296	
PFZ 110A	1N6296A	
PFZ 120	1N6297	
PFZ 120A	1N6297A	
PFZ 130	1N6298	
PFZ 130A	1N6298A	
PFZ 150	1N6299	
PFZ 150A	1N6299A	
PFZ 160	1N6300	
PFZ 160A	1N6300A	
PFZ 170	1N6301	
PFZ 170A	1N6301A	
PFZ 180	1N6302	
PFZ 180A	1N6302A	
PFZ 200	1N6303	
PFZ 200A	1N6303A	
PFZ 220	1.5KE 220	
PFZ 220A	1.5KE 220A	

Industry Part Number	MOTOROLA Direct Replacement	MOTOROLA Similar Replacement
TVS 505		P6KE 6.8A
TVS 510		P6KE 12A
TVS 512		P6KE 15A
TVS 515		P6KE 18A
TVS 518		P6KE 22A
TVS 524		P6KE 30A
TVS 528		P6KE 33A
ZZ 16		P6KE 16CA
ZZ 36		P6KE 36CA
ZZ 62		P6KE 62CA
ZZ 160		P6KE 160CA
ZZY 16		P6KE 16CA
ZZY 36		P6KE 36CA
ZZY 62		P6KE 62CA
ZZY 160		P6KE 160CA
1N5629, A		1N6267, A
1N5630, A		1N6268, A
1N5631, A		1N6269, A
1N5632, A		1N6270, A
1N5633, A		1N6271, A
1N5634, A		1N6272, A
1N5635, A		1N6273, A
1N5636, A		1N6274, A
1N5637, A		1N6275, A
1N5638, A		1N6276, A
1N5639, A		1N6277, A
1N5640, A		1N6278, A
1N5641, A		1N6279, A
1N5642, A		1N6280, A
1N5643, A		1N6281, A
1N5644, A		1N6282, A
1N5645, A		1N6283, A
1N5646, A		1N6284, A
1N5647, A		1N6285, A
1N5648, A		1N6286, A
1N5649, A		1N6287, A
1N5650, A		1N6288, A
1N5651, A		1N6289, A
1N5652, A		1N6290, A
1N5653, A		1N6291, A
1N5654, A		1N6292, A
1N5655, A		1N6293, A
1N5656, A		1N6294, A
1N5657, A		1N6295, A
1N5658, A		1N6296, A
1N5659, A		1N6297, A
1N5660, A		1N6298, A
1N5661, A		1N6299, A
1N5662, A		1N6300, A
1N5663, A		1N6301, A
1N5664, A		1N6302, A
1N5665, A		1N6303, A
1N5907		1N5908
1N5908	1N5908	
1N6267, A thru 1N6303, A	1N6267, A thru 1N6303, A	
1.5KE 6.8, A thru 1.5KE 220, A	1.5KE 6.8, A thru 1.5KE 220, A	

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Le Relecq-Kerhuon — Tel. (98) 28 03 03
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